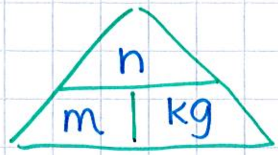
Molality - another way of measuring concentration

$$\text{molality} = \frac{\#\text{moles of solute}}{\text{kg of solvent}}$$

$$m = \frac{n}{kg}$$



Ex)

1. what is the molality (m) of a solution made by dissolving 19.40 g of carbon dioxide in 3.001 kg of water?
   - 19.40 g of carbon dioxide: solute ⇒ n
   - 3.001 kg of water: solvent

12.01
32.00
44.01g

m = ?

solute $n = \frac{19.40 \text{ g } CO_2 \mid 1 \text{ mol}}{\mid 44.01 \text{ g}} = .4408 \text{ mol}$

solvent kg = 3.001 kg

$$m = \frac{n}{kg} = \frac{.4408 \text{ mol}}{3.001 \text{ kg}} = .1469 \text{ mol/kg}$$

or

.1469 m

2. what is the molality (m) of a solution made by dissolving 100.0 g sodium chloride in 350.0 g of water?
   - 100.0 g sodium chloride: solute = n
   - 350.0 g of water: solvent = kg

22.99g
+35.45g
58.44g

m = ?

$n = \frac{100.0 \text{ g NaCl} \mid 1 \text{ mol}}{\mid 58.44 \text{ g}} = 1.711 \text{ mol}$

kg = 350.0 g = .3500 kg

$$m = \frac{n}{kg} = \frac{1.711 \text{ mol}}{.3500 \text{ kg}} = 4.889 \text{ m}$$

Colligative Properties

- depend ONLY on the # of particles dissolved in solution, not on their identity.

- 2 properties

(1) freezing point depression

$\Delta T_f = K_f \cdot i \cdot m$

- ΔT_f: change in freezing pt.
- K_f: freezing pt. depression constant
- i: van Hoff factor → ✶ # ions or molecules in the solute
- m: molality

Ex)
- $C_{12}H_{22}O_{11}$ $i = 1$
- $NaCl \rightarrow Na^{+} + Cl^{-}$ $i = 2$
- $CaCl_2 \rightarrow Ca^{2+} + 2Cl^{-}$ $i = 3$

all covalent molecules ∴ $i = 1$

How do the particles actually change the freezing point?

- They interfere with the solution forming a solid crystal

∴ The temperature must be even colder to force the solution to freeze.

(2) boiling point elevation

$\Delta T_b = K_b \cdot i \cdot m$

- ΔT_b: change in boiling point
- K_b: boiling point elevation constant

How do the solute particles raise the boiling point?

The solute particles slow the solvent particles from escaping as a gas - they physically block them from escaping.

∴ higher temperatures are needed to give the solvent enough energy to break past the solute particles to escape as a gas.

Acids & Bases

Properties

Acids
- taste sour
- electrolytes - conduct electricity
- turns blue litmus paper red
- react w/metals to form H_2 gas
- react w/bases to form H_2O + a salt.

Bases
- taste bitter
- electrolytes
- turn red litmus paper blue.
- react w/acids to form H_2O + a salt

$HNO_3(aq)$ (acid) + $KOH(aq)$ base → $H_2O(l)$ (water) + $KNO_3(aq)$ (salt)

Definitions

Arrhenius acid
- substance that release H^{1+} in solution

Ex) $HCl(aq) \rightarrow H^{1+}(aq) + Cl^{1-}(aq)$

$H_2SO_4(aq) \rightarrow H^{1+}(aq) + HSO_4^{1-}(aq)$

$HSO_4^{1-} \rightarrow H^{1+}(aq) + SO_4^{2-}(aq)$

acids lose 1 H^{1+} ion at a time!

Arrhenius base
- substance that release OH^{-1} in solution

Ex) $KOH(aq) \rightarrow K^{1+}(aq) + OH^{1-}(aq)$

$Ba(OH)_2(aq) \rightarrow Ba^{2+}(aq) + 2OH^{1-}(aq)$

bases lose all OH^{1-} at once!

Bronsted-Lowry acid
substance that donates H^{1+} in solution

All acids have a conjugate base - substance that remains after the acid donates a H^{1+}

Bronsted-Lowry base
substances that accept H^{1+} in solution

All bases have a conjugate acid - substance the base becomes after receiving a H^{1+}

(Ex)

1)	$HSO_4^{1-}(aq)$	+	$F^{1-}(aq)$ →	$SO_4^{2-}(aq)$	+	$HF(aq)$
	A		B	CB		CA
(2)	$NH_3(aq)$	+	$H_2O(l)$ →	$NH_4^{1+}(aq)$	+	$OH^{1-}(aq)$
	B		A	CA		CB
(3)	$HNO_3(aq)$	+	$H_2O(l)$ →	$NO_3^{1-}(aq)$	+	$H_3O^{1+}(aq)$
	A		B	CB		CA